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Chapter Four
PLAN PREPARATION

Other chapters in the *MDT Road Design Manual* provide the designer with uniform criteria and procedures for the geometric design of a highway facility. These designs must be incorporated into the roadway plans so that they can be clearly understood by contractors, material suppliers, and Department personnel assigned to supervise and inspect the construction of the project. To ensure a consistent interpretation of the contract plans, individual sheets should have a standard format and content, and the sequence of plan assembly should generally be the same. To provide this consistency, this chapter provides guidelines for the uniform preparation of contract plans including recommended plan sequence, drafting guidelines, plan sheet content and sample plan sheets.

4.1 GENERAL INFORMATION

4.1.1 Working Sheets

The Department currently uses the following paper sizes during project development:

2. 559 mm x 864 mm (D). This paper size is used for all final plans. Where deemed necessary, this size may also be used for preliminary design reviews (e.g., for complex drawings). Provide a border around the sheet with a 51 mm left-binding margin and 13 mm right, top and bottom margins.

3. 279 mm x 432 mm (B). This paper size is the half-size of the "D" paper and is typically used for preliminary draft reviews, requests for permits and bid advertising. This plan sheet is a half scale of the final plan size in Comment #1. This sheet size may also be used for plotting cross sections on the laser plotter.

4. 216 mm x 279 mm (A). This paper size is used for Pavement Preservation projects. These project types typically contain a minimal amount of design information and, therefore, the smaller sheet sizes are used. If the project contains significant amounts of information, use one of the larger sheet sizes instead.

The above paper sizes will be used until metric paper sizes are routinely available. When available, the following metric paper sizes will be used during project development:

1. 841 mm x 594 mm (A1). This paper will replace the "D" plan sheet for all full-size plans. The sheet will have a 46 mm binding margin and a 15 mm border. The usable plan length will be 700 mm. The plan width will be 300 mm, and the profile width will be 264 mm.

2. 420 mm x 297 mm (A3). This sheet will replace the "B" plan sheet. It will provide a true half scale of the "A1" plan sheet.

3. 297 mm x 210 mm (A4). This sheet will replace the "A" plan sheet, which is used for Pavement Preservation projects.

For the preliminary design stage and for the final design stage of CADD-prepared plans, print all sheets on white paper and use the "B" (A3 metric) paper size. If plans contain any hand-drafted sheets, print all sheets including cross sections on reproducible paper and use the "D" (A1 metric) sheet size. Cross section sheets may be plotted on a reproducible grid paper or, where the CADD file includes the grid, on "B" (A3 metric) paper size. Prior to letting, the designer will be requested by the Contract Plans Section to provide one complete set of half-size plans and cross sections on reproducible paper. Full-size plans and cross sections will be provided when requested. In the future, plans will be submitted electronically to the Contract Plans Section.

4.1.2 Construction Plan Sheet Organization

4.1.2.1 Plan Sequence

To provide consistency from project to project, assemble the construction plan sheets in the sequence below. Note that not all plans will have all the sheets and that several sheets can be combined together (e.g., Table of Contents, Notes). If several sheets are combined, the sequence below still should be followed; that is, they should be listed in order from left to right on the sheet. The recommended plan sequence is as follows:

1. Title Sheet
2. Table of Contents
3. Notes
4. Linear and Level Data
5. Control Traverse Diagram and Abstract Table
6. Typical Sections
7. Summaries
8. Hydraulic Data Summary
9. Detail Sheets:

a. drainage details (including storm drains);

b. special maintenance and protection of traffic through construction zone plans;

c. miscellaneous details (including details for major approaches, interchanges, connections to existing pavement, etc);

d. mass diagram.

10. Plan and Profile Sheets
11. Sanitary Sewer Plans (if not included in Detail Sheets)
12. Water Plans (if not included in Detail Sheets)
13. Signing Plans:

    a. Summary Signing and Delineation Quantities Sheet
    b. Sign Location and Specifications Sheet
    c. Signing Detail Sheets
    d. Plan Sheets

14. Electrical Plans:

    a. Electrical Quantity Summary Sheet
    b. Electrical Detail Sheets
    c. Plan Sheets

15. Bridge Plans:

    a. Title/Quantity Sheet
    b. General Layout of Structure Sheet
    c. Footing Plan Sheet
    d. Bent/Pier Sheet
    e. Erection Plan Sheet
    f. Slab Detail Sheet
    g. Beam/Girder Sheet
    h. Detail Sheets
    i. Standard Sheets

16. Cross Sections:

    a. mainline (including detours)
    b. approach cross sections

4.1.2.2 Sheet Numbering

The title sheet will be considered as page one, but it will not be numbered. Number all other sheets sequentially with the sheet numbers in the upper right-hand corner.

Number road plans with separate, sequential whole numbers. Number cross-section sheets with separate, sequential whole numbers beginning with #1. Sanitary sewer, water, signing, electrical and bridge plans will be numbered separately within each group beginning with #1 and will have the following letter prefixes:

1. Sanitary Sewer Plans — SS*
2. Water Plans — WS*
3. Signing Plans — S
4. Electrical Plans — E
5. Bridge Plans — B

* The Sanitary Sewer and Water Plans will only be designated by the SS and WS prefixes for new installations or extensive modifications to existing systems. The details for minor modifications or additions to existing systems will typically be included in the road plans without a prefix designation. The determination to separate the sanitary sewer and water line details from the road plan details will be made at the Plan-in-Hand.

4.1.3 MDT Detailed Drawings

The *MDT Detailed Drawings* provide information on design elements that are consistent from project to project (e.g., guardrail). They are included in the contract. Section 6.1.4 provides additional information on *MDT Detailed Drawings*.

4.1.4 Temporary Detours and Median Crossovers

The need for separate maintenance of traffic through construction zone plans will vary from project to project. For crossovers or temporary detours, place the detour typical sections with the typical sections, and show the plan and profile views on a separate detail sheet.

Typically, a lump-sum bid item should be used for median crossovers and to construct, maintain and remove detours. Section 5.5.1 provides additional information on lump-sum bid items.

4.2 DESIGN AND DRAFTING GUIDELINES

Project drafting will typically be done by CADD. The following sections provide information on the general design and drafting criteria used by the Department.

4.2.1 Computerized Design

Computers have significantly changed the Department's mode of preparation for its highway plans. Computer-aided drafting and design packages have both simplified and complicated the designer's plan production procedures. Computers have assumed the tedious tasks of drawing cross sections, plotting mass diagrams, calculating grading quantities, etc. They also allow the designer the freedom to develop and evaluate alternatives. On the other hand, they require the designer to be well versed in how to use complex hardware and software. This Section briefly discusses the computer hardware and software MDT uses to prepare its construction plans and MDT's CADD file management.

4.2.1.1 Computer Hardware

1. Equipment. The Department is presently using MicroStation as its computer-aided drafting and design (CADD) package. MicroStation is used with Windows-based PC's. All PC's are connected to file server computers in the Central and District Offices.

   For information on how to purchase, upgrade, replace, maintain or repair CADD workstations or PC's, the designer should contact the Department's CADD Coordinator in the Central Office.

2. Network. All MDT PC's have been networked or interconnected to the Central and District Offices file server computers. The information on District file server computers are downloaded to the Central Office file server computer on a daily basis. This allows designers across the State to access the same information regardless of their location or which machine they are using. To accomplish this, all project files must be saved on the Central or District Office file server computer. The designer is required to download the project files from the file server to their PC at the beginning of each work session. At the end of each work session, the designer is required to upload all project files back to the Central or District Office file server computer.

The Information Services Bureau is responsible for backing up all files on the file server computer and for maintaining the network system. The designer is responsible for maintaining the files in the working directories of the individual computers (e.g., removing out-of-date files) and for backing up files that are not saved to the file server computer.

4.2.1.2 Computer Software

All users outside of the Department network should consult with the MDT CADD Coordinator to determine which version(s) of the software programs are acceptable to the Department. All consultants submitting CADD contract plans to the Department must use the same version as the Department. The Department uses the following design software packages:

1. MicroStation. MDT has selected MicroStation for its Department-wide computer-aided drafting and design software package, which is used for the drafting of most contract plans. Using MicroStation's levels and reference files allows various users within the Department to work on the same set of plans without interfering with each other's design work (e.g., Right-of-Way, Electrical). By integrating or linking MicroStation with other software packages (e.g., GEOPAK, databases), the designer can use the computer to perform the actual design and layout of a project.

   MicroStation is a complex program with many features. If problems or questions occur when using the software, the user should first contact the Lead CADD Operator within each MDT unit or the CADD Coordinator for information on how to use the software.

2. GEOPAK. GEOPAK is a comprehensive, proprietary roadway design package that works as an interactive program within MicroStation. GEOPAK allows the designer to lay out design centerlines and profiles, calculate superelevation, generate cross sections, compute quantities, generate mass diagrams, complete plan labeling, etc. By providing GEOPAK with the minimum/maximum design criteria and other design control points, the designer can command the software to generate all line work for plan views, profiles and cross sections. GEOPAK can also be used to produce 3D model images of the design. Although GEOPAK can generate most roadway quantities, special care must be devoted to the design to ensure that the appropriate symbols, cells and MDT rounding criteria are used.

For more information on GEOPAK, the designer should review the *MDT GEOPAK User's Manual* or contact the Lead CADD Operator in each MDT unit, the MDT CADD Coordinator or the manufacturer.

4.2.2 General Drafting Guidelines

The following provides general guidelines for the plotting of survey data and design details on the plan sheets:

1. Scales. Use the following drawing scales when developing a set of construction plans:

   a. Title Sheet. The layout map should use a 1:60 000 scale. Layout maps for urban areas may use a larger scale for better clarity.

   b. Plan and Profile Sheets. Typically, a scale of 1:1000 should be used for the plan view. For urban and/or small projects, a 1:500 scale may be used. For the profile view, the horizontal scale will be the same as the plan view. The vertical scale will be a 1:10 proportion of the horizontal scale.

   c. Typical Sections. Typical section figures will generally be drawn using a 1:50 scale for both horizontal and vertical dimensions. A 1:100 scale may be used for wide typical sections (e.g., 4-lane highways).

   d. Detail Sheets. Detail sheets will vary according to the element shown. For special intersection or approach drawings, a plan view scale of 1:250 should generally be used. Where necessary to show more detail, scales of 1:200 or 1:100 may be used.

   e. Cross Sections. Cross section scales will typically be prepared using a 1:100 scale. A 1:200 scale may be used where a greater cross section width or height is required. The vertical scale should always be a 1:1 proportion of the horizontal scale.

2. Abbreviations. Figure 4.2A presents a listing of the common abbreviations that should be used where it is necessary to abbreviate elements within the set of plans.

3. Stationing. A metric stationing of 100 m is used by MDT. Show "tic" marks at 20 m intervals.

4. Cross Sections. The line work for cross sections will be drawn with GEOPAK or other Department approved software. The topography will typically be CADD drafted onto the cross sections using MicroStation or GEOPAK

5. Sheet Breaks. Each plan sheet should typically show approximately 700 m of the project location with no overlap.

6. North Arrow. The North arrow on finished plans should be uniform within each set of plans. The standard North arrow CADD cell should be used.

7. Project Block. All sheets, except the title sheet, should have a standard block in the upper right-hand corner indicating the State, project number and sheet number.

&	And
@	At
AB.	Abrupt
A.C.	Aluminum Cap/Asphalt Cement
ADD. EXC.	Additional Excavation
A.A.D.T.	Annual Average Daily Traffic
A.D.T.	Average Daily Traffic
ADJ.	Adjusted
AGG.	Aggregate
AH.	Ahead
APP.	Approach
APPL.	Application
APPROX.	Approximate
ASPH.	Asphalt
ASTM	American Society for Testing & Materials
AVE.	Avenue
AVG.	Average
AZ.	Azimuth
BBLS.	Barrels
B.C.	Brass Cap
B.C.R.	Begin Curb Return
BEG.	Begin
B.E.	Bridge End
BIT.	Bituminous or Bitumen
BK.	Back or Bank
BLDG.	Building
BLK.	Block
B.L.M.	U.S. Bureau of Land Management
BLVD.	Boulevard
B.M.	Bench Mark
BNDRY.	Boundary
BOT.	Bottom
BR.	Bridge
B.R.	Base of Rail
BRG.	Bearing
B.S.	Backsight
B.S.T.	Bituminous Surface Treatment
B.W.FE.	Barbed Wire Fence
C	Cut
C&G.	Curb & Gutter
C/A	Control of Access
C/L	Centerline
CALC.	Calculated
C.A.P.	Corrugated Aluminum Pipe
CATV	Cable TV
CB.	Curb
C.B.	Catch Basin
C.B.W.	Concrete Block Wall
C.C.	Closing Corner
CDTN.	Condition
CEM.	Cement
CH.	Channel or Chain
CH.CH.	Channel Change
CHD.	Chord
CHIS. "x"	Chiseled Cross
C.I.	Curb Inlet
CIR.	Circle
CL.	Class or Clearance
CL-1.2F,1.5F	Chain Link Fence (w/height)
C.M.P.	Corrugated Metal Pipe
C.N.	Concrete Nail
CO.	County or Company
C.O.	Clean Out
COMP.	Compaction
CONC.	Concrete
COND.(TEL.)	Conduit (specify type)
CONN.	Connection
CONST.	Construction
CONST. PMT.	Construction Permit
COR.	Corner
CORR.	Corrected
COV.	Cover
C.P.	Catch Point
CR.	Crushed or Creek
CRS.	Course
C.S.	Curve to Spiral
C.S.F.	Combination Scale Factor
C.S.P.	Corrugated Steel Pipe
C.S.P.A.	Corrugated Steel Pipe Arch
CT.	Court
C.T.B.	Cement Treated Base
CTR.	Center
CULV.	Culvert
D	Distribution of Traffic
DBL.	Double
D.D.	Down Drain
DE	Difference in Elevation
DEFL.	Deflection

PLAN ABBREVIATIONS

Figure 4.2A

DESC.	Description
DEST.	Destroyed
DET.	Detour/Detail
DETC.	Detector
D.H.	Drill Hole
D.H.V.	Design Hourly Volume
D.I.	Drop Inlet
DIA.	Diameter
DIST.	Distance or District
DN.	Down
DP.	Deep
DR.	Drain or Drive
DT.	Ditch
DWG.	Drawing
DY.	Daylight
E	East/External Distance
EASE.	Easement
E.B.	Eastbound
E.C.R.	End Curb Return
E.D.M.	Electronic Distance Measurement or Measurer
E.G.	Edge of Gutter
ELEV. or EL.	Elevation
ELONG.	Elongated
ELY.	Easterly
EMB.	Embankment
EMUL.	Emulsified
E.O.	Edge of Oil
E.P.	Edge of Pavement
EQ.	Equation
E_S	External Distance
E.S.	Edge of Shoulder
E.T.W.	Edge of Traveled Way
EW.	End Wall
EX.	Existing
EXC.	Excavation
EXT.	Extension
EXWY.	Expressway
F.	Fill
F.A.	Federal Aid
F.C.	Flood Control
FD.	Found
FDN.	Foundation
FE.	Fence
FERT.	Fertilizer
F.E.T.S.	Flared End Terminal Section
F.G.	Finished Grade
F.G.S.	Finished Grade Stake
F.H.	Fire Hydrant
FIN.	Finish
FL.	Flush
F.L.	Flow Line
F.P.	Fence Post
FR.	Frontage
FR. RD.	Frontage Road
F.S.	Foresight
FTG.	Footing
FUT.	Future
FWY.	Freeway
G	Grading
g	Gram
GALV.	Galvanized
GAR.	Garage
GEOD.	Geodetic
G.L.	Gas Line
G.L.O.	General Land Office
G.P.S.	Global Positioning System
G.R.	Guardrail
GR.	Grade
GRD.	Grid
GRND.	Ground
GR.SEP.	Grade Separation
G.S.	Gravel Surfacing
G.S.P.	Galvanized Steel Pipe
GTR.	Gutter
G.V.	Gas Valve
ha	Hectare
H&T	Hub & Tack
HDWL.	Headwall
HG.	Headgate
H.I.	Height of Instrument
HO.	House
HOR.	Horizontal
H.P.	Hinge Point
HT.	Height
HWY.	Highway
H.W.	High Water
I	Interstate
I.C.	Incidental Construction
I.D.	Inside Diameter

PLAN ABBREVIATIONS
(Continued)
Figure 4.2A

I.E.	Invert Elevation
INC.	Incorporated
INCL.	Included
INSTR.	Instrument
INT.	Intersection
INTCH.	Interchange
INV.	Invert
I.P.	Iron Pin
IRR.	Irrigation
JCT.	Junction
J.P.	Joint Use Pole
kg	Kilogram
km	Kilometer
L	Length of Curve, Liter
L.C.	Long Chord
L_C	Length of Circular Curve
L.D.	Loop Detector
LENG.	Length - Lengthen
LN.	Lane
L.S.	Land Surveyor
L_S	Length of Spiral
LT.	Left
m	Meter
mm	Millimeter
m^2	Square Meter
m^3	Cubic Meter
mm^2	Square Millimeter
MATL.	Material
MAX.	Maximum
M.C.	Medium Curing
MEAS.	Measured
MED.	Median
MH.	Manhole
MIN.	Minimum, Mineral or Minute
MISC.	Miscellaneous
MKR.	Marker
M.L.	Mainline
MNCPL.	Municipal
M.O.	Mid Ordinate
MON.	Monument
M.P.C.	Mid-Point of Curve
N	North
N.B.	Northbound
N.C.	Normal Crown
N.E.	Northeast
N.G.	Natural Gas
N.G.S.	National Geodetic Survey
NL.	Nail
NLY.	Northerly
NO. or #	Number
N.W.	Northwest
N.W.EL.	Normal Water Elevation
O. or O/S	Offset
O.C.	On Centers or Overhead Crossing
O.D.	Outside Diameter
O.G.	Old Ground or Original Ground
OH.	Overhang or Overhead
O'PASS	Overpass
P	Power Cable or Pipe
P. or PG.	Page
PAVT.	Pavement
P.B.	Pull Box
P.C.	Point of Curve (Beginning)
P.O.C.	Point on Curve
P.C.C.	Point of Compound Curve or Portland Cement Concrete
P.C.S.	Project Control System
P.E.	Preliminary Engineering
PEN.	Penetration
PERF.	Perforated
P.I.	Point of Intersection
P.L.	Property Line
PL.	Place or Plate
PLAS.	Plastic
P.M.	Principal Meridian or Punch Mark
P.M.B.	Plant Mix Base
P.M.P.	Perforated Metal Pipe
P.M.S.	Plant Mix Surfacing
P.O.L.	Point on Line
P.O.V.C.	Point on Vertical Curve
PP.	Pages
P.P.	Power Pole
PREST.	Prestressed
PROC.	Processing
PROJ.	Project or Projected
PROT.	Protect, Protector or Protection
P.O.S.	Point on Spiral
P.O.S.T.	Point on Semi-Tangent
P.O.T.	Point on Tangent

PLAN ABBREVIATIONS
(Continued)
Figure 4.2A

PT.	Point
P.T.	Point of Tangent (End of Curve)
P.T.W.	Present Traveled Way
PVC.	Polyvinyl Chloride
PVT.	Private
PWR.	Power (Lines)
Q	Peak Discharge (Water)
R	Range, Radius, Rise
REC.	Record
RC	Spiral Curve Radius
R.C.	Rapid Curing
R.C.B.	Reinforced Concrete Box
R.C.P.	Reinforced Concrete Pipe
R.C.P.A.	Reinforced Concrete Pipe Arch
RD.	Road
RDL.	Radial
RDWY.	Roadway
REF.	Reference
REINF.	Reinforcement
RET.W.	Retaining Wall
RIV.	River
R.M.	Reference Monument
R.P.	Reference Point, Radius Point
R.R.	Railroad
RT.	Right or Route
RTE.	Route
R/W	Right of Way
RY.	Railway
S	Rate of Full Superelevation, Slope in m per m, Span or South
SA.	Satellite (for traverse use)
SAN. SEW.	Sanitary Sewer
S.B.	Southbound
S C	Slow Curing
S.C.	Spiral to Curve
SCH.	Schedule
SDWK.	Sidewalk
S.E.	Southeast
SEC.	Section or Second
S.G.	Subgrade
SH.	Shoulder
SHT.	Sheet
SIP.	Siphon
S.L.D.	Sea Level Datum
SLOT. DR.	Slotted Drain
SLP.STK.	Slope Stake
SLY.	Southerly
S.P.	Stand Pipe or State Plane
SPEC. PROV.	Special Provision
S.P.H.P.	Steel Pipe, High Pressure
SPK.	Spike
S.S.	Emulsified Asphalt
S.S.P.P.	Structural Steel Plate Pipe
S.S.P.P.A.C.	Structural Steel Plate Pipe Arch Culvert
S.T.	Spiral to Tangent
ST.	Street
STA.	Station
STD.	Standard
STD. SPEC.	Standard Specifications
STK.	Staked or Stake
STL.	Steel
STM.	Storm Drain
STPD.	Stamped
STR.	Structure
SUBD.	Subdivision
SUBGR.	Subgrade
SURF.	Surface or Surfacing
SURV.	Survey
S.W.	Southwest or Sidewalk
T	Township, Tangent Length or Percent Trucks Metric Ton
TAN.	Tangent
T.B.C.	Top Back of Curb
T.B.M.	Temporary Bench Mark
TBR.	Timber
TEL.	Telephone
TEL.C.	Telephone Cable
TELG.	Telegraph
TEL.P.	Telephone Pole
TEMP.	Temperature/Temporary
THK.	Thickness
TK.	Tack
TOPOG.	Topographic
T.P.	Turning Point
TR.	Tract
TRANS.	Transmission Line or Transition

PLAN ABBREVIATIONS
(Continued)
Figure 4.2A

TRAV.	Traverse
TRIA.	Triangulation
T_S	Length of Tangent (Curve with Spirals)
T.S.	Tangent to Spiral
T.T.	Transmission Tower
TYP.	Typical
U	Unit
U.G.	Underground
UNCL.	Unclassified
U'PASS	Underpass
U.S.C. & G.S.	U.S. Coast & Geodetic Survey
U.S.C.E.	U.S. Corps of Engineers
U.S.F.S.	U.S. Forest Service
U.S.G.S.	U.S. Geological Survey
U.S.P.L.S.	U.S. Public Land Survey
V	Design Speed or Velocity
V.A.B.M.	Vertical Angle Bench Mark
V.C.	Vertical Curve
V.C.CORR.	Vertical Curve Offset Correction
V.C.M.	Vertical Control Monument
V.C.P.	Vitrified Clay Pipe
VEH.	Vehicular
VERT. or VT.	Vertical
VIT.	Vitrified
V.P.	Vent Pipe
V.P.C.	Vertical Point of Curve
V.P.I.	Vertical Point of Intersection
V.P.T.	Vertical Point of Tangency
W	West
W/	With
W.B.	Westbound
W.C.	Witness Corner
W.L.	Water Line
WLY.	Westerly
W/O	Without
W.P.	Wing Point
W.S.	Water Service or Warped or Variable Slope
W.T.	Water Table
WT.	Weight
W.V.	Water Valve
W.W.	Wing Wall or Woven Wire
XING.	Crossing
XSEC.	Cross Section

PLAN ABBREVIATIONS
(Continued)
Figure 4.2A

4.2.3 Plotting Survey Data

For surveys conducted by aerial survey, the Photogrammetry and Survey Section will be responsible for plotting the survey data. For data collector surveys, the road designer and surveyor will coordinate to finalize the survey mapping file and create the Digital Terrain Model file. The surveyor and road designer will place the file on the network and will notify the appropriate personnel that the survey information is available. For manually conducted surveys, the designer or consultant will be responsible for plotting the survey data using the Department or approved compatible CADD system. In addition to the field notes, the designer should obtain a copy of the as-built plans (if available) for informational purposes. The as-built plans can be obtained at the MDT Central Office in Helena.

The *MDT Survey Manual* provides the Department's criteria for plotting the survey field notes. In general, plot the survey 200 m beyond the proposed project limits.

For project surveys, an established point is typically assigned a set of coordinate values and the coordinates for all other points are calculated from these assumed values. Global Positioning System (GPS) surveys utilize the NAD 83 State Plane Coordinate Systems. Coordinates should be provided at all major control points on the linear and level data sheet; for additional information, see Section 4.3.4.

4.2.4 CADD Drafting

To help in providing consistency from project-to-project and among designers, the following sections provide Department guidelines for the drafting of construction plan sheets using MicroStation. For specific drafting standards and detailed procedures, the designer should review the *MDT CADD Standards Manual*. Copies of this document are provided to each design crew, or it can be obtained from the CADD Coordinator or viewed on the MDT internet website.

4.2.4.1 File Setup

Each project is saved in its own subdirectory on the Department's central computer. The project subdirectory is named using the project control number provided for each of the Department units involved with the project (e.g., Road Design, Right-of-Way, Survey) under the project directory. The *MDT CADD Standards Manual* provides the subdirectory names that will be used for each of these Department units, as well as the standard file naming convention.

The Department uses a standard file format for the placement of individual plan sheets in the files. For more information on these formats, see the *MDT CADD Standards Manual* or contact either the section lead CADD operator or the CADD coordinator.

4.2.4.2 Reference Files

Reference files allow the various users to integrate several files together from several sources and to view the result from all the files in one view. The project strip map is an example of a reference file that is used by the various designers to develop the project (e.g., Right-of-Way, Traffic, Road Design, Hydraulics). Reference files allow the designers to see how their design will interact with the various other unit designs. Although reference files allow designers to review other unit's files, the designer is unable to make changes to these other files. The designers can only make changes to their own files. It should be noted that, where appropriate, the designer can copy elements from the reference file to their own file.

Separate reference files have been developed containing sheet borders for the following plan sheets:

1. Title/Summaries,
2. Typical Sections,
3. Detail Sheets, and
4. Plan and Profiles.

The designer will create the plan and profile sheet by referencing the strip map for the applicable Section (e.g., Photogrammetry, R/W, Traffic). For more information on reference files, the designer should review the *MDT CADD Standards Manual* or contact their section lead CADD operator or the CADD Coordinator.

4.2.4.3 Cell Libraries

For plan consistency, the Department has developed a set of symbols that should always be used to indicate certain elements. For symbol uniformity and ease of drafting, these symbols have been incorporated into the Department’s CADD cell libraries.

Cell libraries are developed to allow the CADD user to call up a symbol, figure, form, etc., without having to redraw the figure each time. The *MDT CADD Standards Manual* lists the cell libraries that are available for the designer's use.

To obtain a copy of these cell libraries, MDT employees should contact the CADD Coordinator or their section's lead CADD operator. Outside consultants should request a copy of the cell libraries from the Consultant Design Section or download them from the Department's Internet web site.

4.2.4.4 Drafting Levels

MicroStation allows the user to select up to 63 different levels to input data. The *MDT CADD Standards Manual* provides guidelines for what information should be provided on each level. Because units other than the Road Design Section utilize the information contained on the various levels, placement of data on the correct level is essential. Presenting the project data on different levels allows the user to see or print only the desired data by turning on or off the various levels.

4.3 PLAN SHEET CONTENT

Prepare the construction plans as simply as practical. Avoid the use of duplicated data and unnecessary cross references. Section 4.4 provides model drawings for various plan sheets. The following sections provide additional information on what should be included within each sheet. Section 4.2.4 provides information on text sizes, font types, symbols, cell libraries and drafting levels that should be used for each plan sheet.

4.3.1 Title Sheet

The Title Sheet is the front cover for a set of plans. It identifies the project type, project location and other pertinent project information. Pre-drafted title sheets are available as reference files. Pre-drafted sheets provide the State map and blocks for design data, project approvals, related projects and associated project agreement numbers. Also shown is the Department name and standard data for scales and project length.

The Title Sheet should contain the following information:

1. State Map. A state map in the upper left-hand corner of the sheet should show the general location of the project in relation to other roads within the State. An arrow labeled "THIS PROJECT" will indicate the project location.

2. Title Information. Show the project title information in the top center of the sheet in the following order:

    a. Montana Department of Transportation.

    b. Project construction number as provided by the Fiscal Programming Section. Figure 4.3A defines the project number codes.

    c. Project descriptions as provided in the Engineering Management System Report.

    d. Project name. The project name must match the name on the project's programming document and the name shown in the Project Management System.

    e. Access control note, if applicable.

    f. County name.

Project NH1-9(23)565

NH-Funding Designation (see table below)

1 - Route Number

9 - County Designation along the route (west to east, south to north)

23 - Agreement Number

565 - Reference Point on the Route

Federal-Aid Program	Project Prefix
Interstate Program:	
Interstate – Maintenance	IM
National Highway System:	
National Highway	NH
Surface Transportation Program:	
Secondary	STPS
Urban	M, STPU
Primary (minor arterial)	STPP
State Flexible (State Highway)	STPX
Rail/HWY Crossing - Hazard Elimination	STPRR
Rail/HWY Crossing - Protective Devices	STPRP
Hazard Elimination	STPHS
Transportation Enhancements	STPE
Bridge Program:	
Bridge Replacement & Rehabilitation - 20% (Optional)	BR & BH
Bridge Replacement & Rehabilitation – 15% (Off-System)	BR & BH
Bridge Replacement & Rehabilitation – 65% (On-System)	BR & BH
Congestion Mitigation & Air Quality Improvement Program:	
Congestion Mitigation & Air Quality	CM
SPR/PL Program:	
HWY Planning & Research	SPR
Research, Development & Technology Transfer	SPR
Metropolitan Planning	PL
Innovation Projects:	
DPI Projects (Shiloh & Missoula Interchange)	DPI
Demonstration Projects:	HDP
Discretionary Funds:	
Public Lands	PLH
Forest Highway	FH
State-Aid Program	**Project Prefix**
National Highway System:	
National Highway (less Interstate)	RTF
State Primary	RTF
State Secondary	RTS
State Urban	RTM
State Highway (State maintained)	RT

PROJECT CODE DEFINITION

Figure 4.3A

3. Project Length. Show the net contract length of the project to the nearest tenth of a kilometer (i.e., 0.1 km) immediately below the title information.

4. Scales. Show scales of plan and profile sheets, cross sections and reduced sheets immediately below the project length.

5. Surfacing Source. Just to the right of the scales, indicate whether or not the surfacing source is contractor furnished for the project.

6. Design Data. Include project design data in a block in the upper right-hand corner. For those projects having two or more road segments with different design data, prepare separate design data blocks for each segment.

7. Letting Date. The letting date recorded in the upper right-hand corner will represent the actual letting date, not the proposed letting date.

8. Layout Map. The layout map is located at the bottom center of the Title Sheet. Reference the layout map from the county maps directory — MAPS/SS. "SS" is the subdirectory under "Maps." The designer should only show the area necessary for the project. The map should not remain referenced to the Title Sheet file as it is too large a file. Copy the portion of the map that shows the project onto the Title Sheet. The standard scale for rural layout maps is 1:60 000 and should be used wherever practical. Layout maps for urban-area work should show enlarged views of the urban areas affected.

   The layout map should clearly show the following:

   a. the location of the project roadway in relation to true north, nearby townships, ranges, sections, existing roads, towns, major drainage features, State-optioned borrow and surfacing sources, railroads and buildings;

   b. the beginning and ending stations of the project and project number;

   c. the numbers and stations of as-built projects onto which the project is tied;

   d. names of interchanges;

   e. signed route numbers for U.S., State and local highways;

   f. enlarged maps of cities and towns where construction is scheduled through those areas;

g. the name of the Indian reservation, when any portion of the project is located within the boundaries of a reservation;

h. separation structures and bridges on the project. A single station number, based on mainline stationing, will represent the approximate center of each structure. Data will indicate the length of each structure, whether it is an overpass or underpass in relation to the main line and whether it will be constructed under this contract;

i. do not show non-optioned surfacing or borrow pits on the layout map or elsewhere on the Title Sheet; and

j. for an index to the map symbols, reference the MDT CADD Standards Manual.

9. Related Projects. Provide a block for related projects in the lower left-hand corner of the sheet. Data for "Related Projects" include contract units not covered by the contract plans and project numbers financially related to the main project (e.g., projects constructed in stages or units, projects tied for letting).

10. Associated Project Agreement Numbers. Show associated project agreement numbers for right-of-way, incidental construction (utilities), preliminary engineering and uniform project control number under the related project box.

11. Project Approval Block. A project approval block will be shown in the lower right-hand corner of the sheet. The approval box should include:

a. the contract plan approval date;
b. the Director's name;
c. the Preconstruction Engineer's signature;
d. the Preconstruction Engineer's professional registration symbol; and
e. where appropriate, the FHWA Division Administrator's approval.

4.3.2 Table of Contents Sheet

Include a table of contents in each set of construction plans. One sheet is generally used solely for the table of contents, although notes may be placed on the same sheet if sufficient room is available. Each group of information must be clearly labeled "TABLE OF CONTENTS," "NOTES" and "LINEAR AND LEVEL DATA" and be placed in order from left to right, respectively.

The table of contents will indicate the major groups of sheets and those subgroups necessary to facilitate locating each item in the plans. Section 4.1.2 provides the proper order for listing, numbering and prefixing the plan sheets.

4.3.3 Notes Sheet

Include a notes sheet in each set of contract plans. One sheet is generally used solely for notes, except where the notes can be readily placed on the same sheet with the table of contents.

Notes sheets will provide general information necessary for plan users to obtain a complete understanding of the contract plans. Notes should not be used where subjects are addressed in the Standard or Supplemental Specifications or Special Provisions. Examples of information that may be addressed include:

1. descriptions of items to be removed by non-contractor personnel;

2. instructions for the contractor regarding items not to be disturbed, clearing and grubbing and digout areas;

3. descriptions of work items absorbed in the cost of bid items;

4. bases for plan quantities of surfacing materials;

5. instructions for interpreting the plans;

6. a skew diagram, if applicable; and

7. a clear zone table on all projects that involve grading, utility conflicts, R/W acquisition and new signing. The table should include the clear zone widths applicable to the project for all fill slopes 3:1 or flatter, cut sections and for the outside of horizontal curves. For non-recoverable slopes, the distance shown in the clear zone table will be the distance the clear zone extends beyond the toe of fill. For additional guidance, see Section 14.2. If there is only one clear zone on a project (e.g., the clear zone width is less than the subgrade width), indicate the clear zone with a note rather than providing a table.

The sample note sheet in Section 4.4 provides a sample listing of notes that are commonly included in a set of plans.

4.3.4 Linear and Level Data Sheet

Include a linear and level data sheet within each set of construction plans. Generally, only use one sheet for linear and level data, except where it can be readily placed on the same sheet with the table of contents and notes. Linear and level data sheets will show a summary of project lengths, a tabulation of bench mark data, the sources of bearing and level data, and centerline coordinate table. The linear and level data sheet should contain the following information:

1. Project Lengths. Summarize project lengths by showing roadway lengths, bridge lengths and total lengths for each of the following:

   a. each route,
   b. 2-lane sections,
   c. 4-lane sections,
   d. sections financed separately,
   e. sections in different counties, and
   f. areas not included in the contract within the project limits.

   Bridge lengths are measured from the centerline of bearing to the centerline of bearing of the end bents. Formats of length summaries should clearly identify the sections for which individual lengths are shown (e.g., 2-lane/4-lane, funding type). Calculate the lengths in meters to two decimal places (i.e., 0.01 m). See Section 4.4 for a sample of a linear and level data sheet.

2. Bench Mark Table. Bench mark tabulations should show the station, location, description and elevation of each bench mark. Show bench mark locations referenced to the mainline first, followed by bench marks referenced to other lines in the order they appear along the mainline.

   Clearly identify the road or line to which a group of bench marks is referenced. Tabulate each group of bench marks in the order of increasing stations. Show elevations in meters to three decimal places (i.e., 0.001 m).

   For projects having control traverses, the z-coordinates of the transverse points can be used as the vertical control. Where these coordinates are available, the bench mark data is not required.

3. Bearing Source. State the source used to take the bearings (e.g., previous surveys, adjacent projects, solar observations).

4. Level Datum Source. A detailed description will be provided to locate the bench mark used for the level datum source. The description should include the bench mark location, elevation, number and any other pertinent information.

5. Centerline Coordinate Table. The coordinate table should show the station, description, east or X coordinate, north or Y coordinate, and any appropriate remarks. Show the coordinates to four decimal places (i.e., 0.0001 m). Coordinates are typically provided for:

   a. the project's beginning and ending points of the mainline, side roads, or any other splits described in Comment #1;

   b. PC;

   c. PI;

   d. PT;

   e. TS;

   f. SC;

   g. CS;

   h. ST; and

   i. station equation points.

6. Control Point Table. Provide a Control Point Table for projects that do not have a control traverse. This table should include the point identification, the northing (y-coordinate) and easting (x-coordinate), elevation (z-coordinate) and the description of the point.

7. As-Built Projects. List the project numbers of the as-built projects that encompass the proposed project.

4.3.5 Control Traverse Diagram

8. The control traverse diagram is used to establish a permanent, recoverable horizontal and vertical control system for highway design and construction. All topographic features, section corners, controlling property corners, geological data, hydrological data, existing right-of-way and miscellaneous design information are tied to the control traverse. The control traverse will also be used

to layout the design centerline and right-of-way. During construction, if a control point is destroyed or becomes unusable, a new control point can be set using the control traverse diagram. Use the following guidelines to plot the control traverse diagram:

1. Scale. The diagram will generally be drawn using a 1:12 000 scale. However, the scale may need to be changed so that the diagram will fit onto one sheet.

2. Segments. The diagram can be broken into segments on the sheet to allow for a better fit.

3. Coordinates. Round all of the control traverse points to four decimal places (i.e., 0.0001 m) and plot them using coordinated plotting (i.e., x, y and z). These coordinates are used by the CADD system to plot the control traverse diagram and map files. Note on the control transverse diagram when State Plane Coordinates are used. Also include the combination scale factor on the diagram and on all plan and profile sheets.

4. Identification Number. Show the control point identification number next to the control point.

5. Congested Areas. In congested areas where the control points plot close together, provide a detail, which does not need to be to scale, to show the relative positions and lines of sight.

6. Symbol. Plot control points using the standard CADD cell.

7. Abstract. The control traverse diagram will require an abstract summarizing the important aspects of the survey control points. If practical, the abstract should be placed on the same sheet as the diagram. The abstract may be placed on a separate sheet or may be incorporated onto the linear and level data sheet. The abstract should contain:

    a. the point identification number,

    b. the easting or x coordinate,

    c. the northing or y coordinate,

    d. the point elevation or z coordinate, and

    e. a description on how to find or reach the control point.

4.3.6 Typical Sections

One or more typical sections are required for each set of plans. Typical sections are used to illustrate the cross section for a roadway section, the basis for surfacing quantities, roadway widths for tangent and superelevated sections, and cut and fill slope rates. Provide a separate typical section for each of the following situations:

1. tangent sections;

2. superelevated sections;

3. where there are changes to the pavement structure;

4. where there are changes from a curbed section to a non-curbed section or vice versus;

5. side approaches and roads which have a significant length of reconstruction;

6. cross section changes (e.g., shoulder additions, median changes); and

7. specially constructed detours.

Changes in pavement width are generally shown on separate typical sections. For extremely localized changes in pavement width (e.g., turnouts, chain-up areas), the change may be shown on a detail with the additional quantities included in the appropriate frames. Separate typical sections may be required when transitioning from a reconstructed or new section to an existing section or connection to PTW. Provide a typical section with the corresponding quantities if the connection is greater than 300 m or if the transition is on a horizontal curve. For connections less than 100 m, it will generally be presented on the plans as a transition from one of the other typical sections. The need for a separate typical section for intermediate lengths will be determined on a case-by-case basis.

Prepare typical sections using the following guidelines:

1. Orientation. Orientate all typical sections horizontally (landscaped) on the sheet.

2. Scale. Draw typical sections using a scale of 1:50, both horizontally and vertically. A 1:100 scale may be used for wide typical sections (e.g., 4-lane highways).

3. Order. Show the mainline typical sections first, followed by the other sections in the order they appear in increasing stations along the mainline.

4. Titles. Number each typical section sequentially. The first typical section should be No. 1, the second No. 2, etc. Also include the name of the road to which the typical section applies directly below the typical section number.

5. Frontage/Access Roads. Reference the beginning and/or end of frontage and access roads with respect to the mainline stationing.

6. Station Limits. List the station limits for which the typical section applies in the upper right-hand corner of each typical section. Station limits should also be included for bridge ends. The limits should extend from centerline of bearing to centerline of bearing for each bridge. Transitions from one typical section to another should be stated next to the station limits (e.g, TRANS. TYP. 3 TO TYP. 4). Include the transition note on the preceding typical section. Transition call outs are required at all typical section changes. Where transitioning from a tangent section to a superelevated section, the transition stationing begins at the beginning of the tangent runout and ends where full superelevation is achieved, not at the PC, PT, TS, ST, etc. The station limits for superelevated sections should be followed by the appropriate superelevation and direction of curve (e.g., 7% RT).

7. Cross Section. The typical section cross-section view should show the following elements:

   a. the grading template, including non-standard slope designs;

   b. profile grade line reference;

   c. surfacing templates for immediate and future development;

   d. types of surfacing and thicknesses shown to the nearest 5 mm.

   e. dimensions from which cuts and fills are staked; and

   f. slopes and dimensions necessary to define the typical section. Use dimensions instead of slopes wherever the typical section can be defined with dimensions. Cross slopes should typically be shown to the nearest percent (i.e., 1%). Show subgrade widths and finished top widths in meters to one decimal place (i.e., 0.1 m), and intermediate pavement widths to the nearest hundredth of a meter (i.e., 0.01 m).

8. Slope Table. Include fill and back slope slopes tables where back or fill slopes are presented as variable on the typical section.

9. Quantities Frame. Show the quantities of aggregate and bituminous materials represented by the typical section underneath the typical section figure. Superelevated sections which have the same basic quantities may reference the appropriate tangent typical section. Section 5.4.2 provides the rounding criteria that should be used in the quantity frame.

10. Width Table. A width table showing the roadway widths should be provided for each superelevation rate for a given typical section. Where only one superelevation rate occurs for a typical section, show the dimensions in the same manner as for a tangent typical section. Figure 4.3B illustrates a sample width table.

% SUPER	WIDTH TABLE (m)						
	A	B	C	A'	B'	C'	D'
5	5.57	6.00	7.8	5.21	5.44	6.8	1.0
7	5.73	6.25	7.8	5.19	5.40	6.7	1.1

Note: Non-primed letters are for the dimensions left of the design centerline and primed letters are for those right of the design centerline.

SAMPLE WIDTH TABLE
Figure 4.3B

11. Notes. The R-values of the subgrade material, which are the basis for surfacing design, will be shown on the typical section. Design and construction notes that are only pertinent to the specific typical section may also be included on the typical section.

12. Special Borrow. Show special borrow on the typical section if it is provided in the surfacing recommendations from the Pavement Analysis Section. When special borrow is included in the typical section, the subgrade shown on the cross sections is located at the bottom of the special borrow. The surfacing subgrade is the bottom of the surfacing section exclusive of the special borrow. If the special borrow is added later to address a site condition or discovered after the surfacing is designed, only show it on the cross sections.

13. CADD Cells. Standard CADD cells are available for the slope table, the quantities frame, the width table and other typical section elements.

14. CADD Drafting. The MDT CADD Standards Manual provides drafting and dimensioning guidelines for typical sections.

4.3.7 Summary Sheets

One or more summary sheets will typically be included in each set of construction plans. Summary sheets will show all quantities of work and materials required by the plans. No other data will be shown on the summary sheets. Chapter Five presents the guidelines for developing plan quantities. Prepare the summary sheets according to the following guidelines:

1. CADD Cells. Figure 4.3C provides a listing of the typical summary frames and the corresponding CADD cell name for each summary frame. Additional frames may be required for specialty items. Their use will be determined on a project-by-project basis.

2. Frame Adjustments. The summary frames may need to be adjusted for the project. The frames should include three blank lines between the last quantity and the total. Additional lines may be required for large projects. When developing new summary frames, start with an existing cell and use the format shown in sample plans sheets in Section 4.4. Blank-out or remove columns within the frame that are not used to eliminate possible confusion.

3. Stationing. Stationing within each summary frame should be sequential wherever practical. Figure 4.3C provides the recommended station listing procedure that should be used within each frame.

4. Rounding. Chapter Five presents the rounding procedure that should be used within each summary frame.

5. Placement. Place quantities so that the largest number is centered under the description of the item, and align all other numbers so that all numbers in an individual column have the same place value. Use spaces in place of commas to separate blocks of three digits. A period (.) will be used to signify the decimal point. Place a zero in front of the decimal point for numbers less than one.

Frame	Cell Name	Sample Sheet Figure	Stationing Listing Requirements* Description
Grading (uncl. exc.)	GRADEX	Fig 4.4K-1	Stations from balance point to balance point.
Additional Grading (uncl. exc.)	ADDEX	Fig 4.4K-1	Beginning and end stations or each location.
Grading (Embankment-in- Place)	GRADEM	Fig 4.4K-1	Beginning and end stations or each location.
Additional Grading (Embankment-in-Place)	ADDEM	Fig 4.4K-1	Beginning and end stations or each location.
Subexcavation	SUBEXC	Fig 4.4K-1	Beginning and end stations of each location.
Digout Excavation	DIGOUT	Fig 4.4K-1	Each location station or beginning/end station.
Muck Excavation	MUCKEX	Fig 4.4K-2	Beginning and end stations of each location.
Clearing and Grubbing	CLEAR	Fig 4.4K-2	Beginning and end stations of each location.
Remove Structures	RESTRC	Fig 4.4K-2	Center location station.
Equipment	EQUIP	Fig 4.4K-2	Beginning and end stations of each location.
Road Leveler Operations	LEVOP	Fig 4.4K-2	Beginning and end stations of each location.
Embankment Protectors	EMPRO	Fig 4.4K-2	Beginning and end stations of each location.
Bluetop Staking	BLUTOP	Fig 4.4K-2	Beginning and end stations of each location.
Mailboxes	MAILFR	Fig 4.4K-2	Each location station.
Special Borrow	SPBRW	Fig 4.4K-2	Beginning and end stations of each location.
Culvert Frame (Optional)	OPCULV	Fig 4.4K-3	Each location station.
Culvert Frames No Options	CULNOP	Fig 4.4K-4	Each location station.
Culvert Summary Recap	CULVRE	Fig 4.4K-4	Total for whole project.
Stockpass	STKPS	Fig 4.4K-4	Each location station.
Underdrain	UNDR	Fig 4.4K-4	Beginning and end station of each location.
Concrete Drainage Chutes	CONCDR	Fig 4.4K-4	Each location station.
Surfacing	SURF1	Fig 4.4K-5	Beginning and end Sta. of applicable typical section.
Additional Surfacing	ADSURF	Fig 4.4K-5	Beginning and end stations of each location.
Cold Milling	MILL	Fig 4.4K-6	Beginning and end stations of each location.
Bituminous Pvmt Removal	BITPAV	Fig 4.4K-6	Beginning and end stations of each location.
Pulverization	PULVL	Fig 4.4K-6	Beginning and end stations of each location.
Sidewalk	SIDWLK	Fig 4.4K-6	Beginning and end stations of the BAR.
Curb	CONCUR	Fig 4.4K-6	Beginning and end stations of the BAR.
Obliterate Roadway	OBLIT	Fig 4.4K-6	Beginning and end stations of each location.
Rumble Strips	RUMSTR	Fig 4.4K-6	Beginning and end stations of each location.
Pavement Marking	PAVEMK	Fig 4.4K-6	Total for whole project.
Concrete Median Rail	CONBAR	Fig 4.4K-7	Beginning and end stations of each location.
Topsoil & Seeding	TOPSO	Fig 4.4K-7	Approximately every 10 stations.
Random Riprap	RIPRAP	Fig 4.4K-7	Each location station.
Guardrail	METGRD	Fig 4.4K-7	Beginning and end stations of each location.
Median Concrete Curb	CONMED	Fig 4.4K-7	Beginning and end stations of each location.
Detour (Construct, Maintain & Remove)	DET	Fig 4.4K-8	Each location station or beginning/end station.
Fencing	FENCE	Fig 4.4K-8	Beginning and end stations of each type.
Cattle Guards	CATGRD	Fig 4.4K-8	Each location station.
Median Crossover	MEDXOV	Fig 4.4K-8	Begin and end station of each location.
Temporary Guardrail	TEMPGR	Fig 4.4K-8	Begin and end station of each location.
Miscellaneous Items	MISC	Fig 4.4K-8	Each location station.
Waterline	WATLNE	Fig 4.4K-9	Each location station.
Approach	APPIO	Fig 4.4K-9	Each location station.
Water Valve Boxes	WTRADJ	Fig 4.4K-9	Each location station.
Manhole in Place	MANHOL	Fig 4.4K-9	Each location station.
Storm Drain	STORM	Fig 4.4K-9	Beginning and end station of each location.
Approach Pipe	APPIPE	Fig 4.4K-10	Each location station.
Irrigation Structures	IRRSTR	Fig 4.4K-10	Each location station.
Plant Mix Lined Ditch	PMLIDI	Fig 4.4K-10	Beginning and end stations of each location.
Concrete Lined Ditch	COLIDI	Fig 4.4K-10	Begin and end station of each location

**See Chapter Five for additional information on how to determine quantities.*

SUMMARY FRAMES

Figure 4.3C

6. Separate Frames. Separate frames may be required for the same items when more than one funding is utilized on a project. For more information on when separate frames should be used, see Chapter Five.

4.3.8 Hydraulic Data Summary Sheet

The hydraulic data sheet contains the information on culvert sizes ($ 800 mm in diameter), bridges, longitudinal encroachments, flood data and other necessary hydraulic data. This sheet is prepared by the Hydraulics Section. The road designer is responsible for incorporating it into the plans.

4.3.9 Detail Sheets

4.3.9.1 General

Detail sheets are used for those items that require more specific information than can be adequately described on either the plan or the profile views of the plan and profile sheets. Detail sheets are used to show:

1. drainage details (including storm drains);

2. special maintenance and protection of traffic through construction zone plans;

3. miscellaneous details (including details for major approaches, intersections, interchanges, connections to existing pavement, etc);

4. contour grading plans;

5. standard details; and

6. mass diagrams.

Clearly label each detail in the title box in the lower right-hand corner of the space allotted to the detail. In the title box, show the name of the detail, the station(s) to where it applies and the scales to which it is drawn, if appropriate. The initials of the person who drew and checked the detail and the dates of the drawing and checking should appear in the lower left-hand corner of the space allotted to the detail.

A mass diagram detail sheet is included in the construction plans for projects utilizing unclassified excavation. Mass diagrams are typically not required for embankment-in-place projects or urban projects. The mass diagram provides a capsule view of the

earthwork quantities and how they could be moved. See Section 5.2.5 for more information on mass diagrams. Scale the mass diagram so that it can be placed onto one page. Figure 4.3D illustrates how to scale the mass diagram to fit onto one page. Where practical, the mass diagram should be continuous with no breaks. The mass diagram should contain the following information:

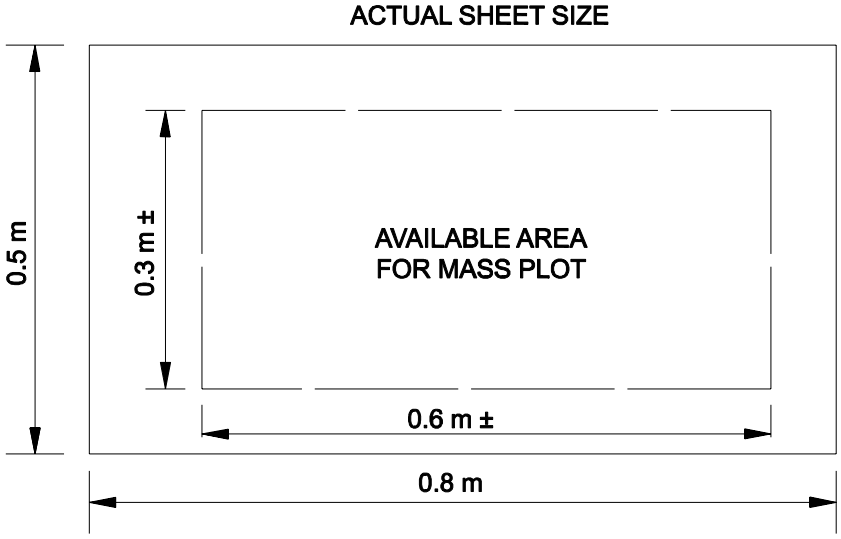
1. begin and end stations with the project number;
2. mass curve and balance line;
3. balance point station, to the nearest meter;
4. volumes of unclassified excavation, embankment +, and haul between balance points;
5. borrow or excess volumes, if applicable;
6. shrink/swell factor;
7. a note stating "Haul shown for information only"; and
8. a scale for horizontal and vertical units, see Figure 4.3D.

Section 5.2.5 provides additional information on how to use a mass diagram.

Plan views of geometric layouts are used where the mainline plan and profile sheets cannot adequately show horizontal alignment details of large or complex facilities such as major intersections. The contents of geometric layouts generally should be the same as the contents of plan views on mainline plan and profile sheets, except that the topography will not be shown and the name of the features should be clearly shown on the right side of the detail.

4.3.9.2 Straightline Diagrams

Straightline diagrams provide only the plan view of the roadway and can be categorized into three formats. The designer should select one of the following formats depending on the work involved:



1. Actual length of project (m) ÷ 0.6 m = horizontal scale

2. Difference of most extreme mass ordinates (m3) ÷ 0.3 m = vertical scale

Note: Round scales to multiple of available scales on ruler (e.g., 1:100, 1:200, 1:250, 1:300, 1:400, 1:500).

* * * * * * * * * *

Example

Given: Length of project = 8825.36 m

Highest mass ordinate = +101 320 m3

Lowest mass ordinate = -74 176 m3

8825.36 ÷ 0.6 = 14 709.9 Round Y 1:15 000 horizontal scale

101 320 - (-74 176) = 175 496 ÷ 0.3 = 584 986 Round Y 1:600 000 vertical scale

* * * * * * * * * *

SCALING A MASS DIAGRAM

Figure 4.3D

1. Straightline Sheets. These sheets are typically used for overlay projects having no R/W involvement. The horizontal alignment is represented by straight lines. Curves are not depicted but curve data is provided. Two or three segments of roadway may be shown on a sheet depending on available space. Scales other than 1:1000 may be used.

2. Plan Sheets. These sheets are typically used for widening and overlay projects requiring R/W acquisition or construction permits. These sheets should utilize a 1:1000 scale. They are very similar to the "plan" portion of plan and profile sheets. Information which is normally included on the profile may be shown on these sheets (e.g., guardrail).

3. Detail Sheets. These sheets may be used for special cases involving extensive additional work. They will utilize the same format as the plan sheets described above, but quantities will be listed on the plan sheet for clarify.

4.3.10 Plan and Profile Sheets

The plan and profile sheets are the basic design sheets used by the designer to illustrate the horizontal and vertical alignments and to depict the construction items and the topography necessary for construction. Therefore, the designer needs to ensure that these sheets are drawn with clarity and are as simple as practical, but still provide the necessary information to construct the project.

4.3.10.1 General Guidelines

The following provides several guidelines for the preparation of the plan and profile sheets:

1. Views. The Department's practice is to provide the plan and profile on the same sheet. The plan view is shown in the upper half of the sheet with the corresponding profile view shown directly below it.

2. Sequence of Sheets. Show the mainline plan and profile sheets first, in the order of increasing stations. Project stationing typically increases from south to north and west to east. Do not interrupt the continuous stationing of the mainline plan and profile sheets with the insertion of plan and profile sheets for other facilities (e.g., side roads, frontage roads, railroads). Insert these additional plan and profile sheets after the mainline sheets in the order they appear along the mainline.

3. Labeling. Clearly label all additional plan and profile sheets on the right side so that the plan user can readily determine what plan and profile is being shown.

4. Sheet Overlap. There should be no sheet overlap between successive sheets (i.e., use match marks). Generally, layout the sheets so that approximately 700 m of the project is shown on each sheet. However, this may be adjusted as needed on a sheet-by-sheet basis.

5. Note Orientation. In general, write all notes and dimensions horizontally from left to right, except for the following:

   a. Plan Views. Pipe, irrigation facilities, bridges and storm drain installation notes are placed vertically at the bottom of the plan view. Stationing, at 100 m intervals, is placed radially approximately 100 mm above the centerline. Curve data is placed radially on the inside of the curve. The curve data should be placed on the left side of the line (back on line), because R/W data is always placed on the right side (ahead on line). Place curve controls, equations and angle points at right angles to the centerline in accordance with Figure 4.3E.

   b. Profile Views. Write equations diagonally. Full stations and elevations of VPI, pipe stations, begin/end stations and bridge end stations should be written vertically. Place any notes above the profile.

   c. Special Considerations. Where limited space for notes and dimensions makes horizontal placement detrimental to the readability of the plans, they may be placed vertically or below the profile.

Do not write notes or dimensions from right to left in an inverted position. See Figure 4.3E for the proper way to illustrate notes.

ORIENTATION OF NOTES

Figure 4.3E

6. Use of Notes. Notes on plan sheets should be brief, clear and consistent. Indicate any installations and removals by station and provide a brief description. Do not include detailed descriptions on the plan and profile sheets. These should be placed on the Note Sheet. Typical notes for some common items are shown in Figure 4.3F.

7. Drafting Details. Figure 4.2A provides the recommended abbreviations that should be used. Section 4.2 also provides additional drafting details that should be reviewed when preparing plan and profile sheets.

4.3.10.2 Approaches

Correct approach designations are required for R/W purposes. However, during design it may be difficult to determine the appropriate designation (e.g., private or farm field). Designers should use their best judgment to designate approaches during design. When R/W agreements become available, the designer should check the agreements to ensure that the appropriate approach designations are provided in the plans. The following defines the various approaches:

1. Public Approaches. Public approaches are connections to and/or from a highway, street, road, alley, etc., or dedicated public right-of-way.

ITEM	TYPICAL NOTE
New culvert (optional)	65 + 00 NEW 600 mm DR
New culvert (non-optional)	65 + 00 NEW 600 mm CSP.DR.
Existing culvert to be removed	70 + 30 610 mm C.M.P. IN-PLACE REMOVE
New approach	75 + 20 PUBLIC APP. RT.
New riprap	92 + 35 to 93 + 80 CL.2 RIPRAP RT.
Subexcavation	82 + 00 to 83 + 30 SUBEXC.

TYPICAL PLAN AND PROFILE NOTES

Figure 4.3F

2. Private Approaches. Private approaches are permanent entrances to and/or from a commercial, industrial or residential property.

3. Farm Field Approaches. Farm field approaches are revocable entrances to and/or from a field.

When designating approaches, the designer should consider the following:

1. Limited Access Control Projects. R/W will provide the designer with the "Limited Access Control Recommendations," which provides the designations for all approaches within Limited Access Control. Listed below are the appropriate approach designations to be used with the station and location (LT or RT) for call out on plan sheets and cross sections:

   Public APP.
   Private APP.
   *Private APP. (future)
   Private APP. (joint)
   *Private APP. (future-joint)
   Farm Field APP. (revocable)

   *Future approaches will be called out, but not drawn on the construction plans or cross sections nor the quantities computed.

   Example:

   200 + 50
   FARM FIELD APP. LT.
   (REVOCABLE)

2. Regulated Access Projects. R/W will not provide the designer with recommendations of designation for approaches. The designer will make this determination from "existing use" or R/W agreements, if applicable. Listed below are the appropriate approach designations to be used with the station and location (LT or RT) for callouts on plan sheets and cross sections:

   PUBLIC APP.
   PRIVATE APP.
   PRIVATE APP. (JOINT)
   FARM FIELD APP.

Example:

100+20
PRIVATE APP. LT.

3. Widths. Approach widths other than 7.2 m should be noted on the plan sheets and cross sections. For urban projects, show all approach widths.

Example:

20+00
FARM FIELD APP. LT.
12 m TOP

4.3.10.3 Preliminary Plans

There are several items that are only shown on the preliminary design plans. Do not include these items in the final plans. The information that may be shown in the preliminary plans includes:

1. Utilities Plans. In general, utility plans are the responsibility of the Right-of-Way Bureau. Where utility items exist within the project construction limits, the road designer should denote on the construction plans provided to the R/W Bureau the following information:

   a. Above Ground Utilities. Existing above ground utilities such as power poles, telephone pedestals, gas and water valves, fire hydrants, etc., located within proposed construction limits should be circled and labeled with a station and distance from the design centerline.

   b. Underground Utilities. Existing underground utilities located longitudinally and within the proposed construction limits do not have to be circled or called out as a conflict, but still should be shown on the plans.

   c. Utility Clearances. Existing utilities above or below ground and crossing the design centerline should be called out by depth or clearance. If these items are not known, they should be called out as “depth unknown” or “clearance unknown”.

   d. Utility Hazards. Telephone and power poles, which include guy wires, located within the clear zone as defined in Section 14.2 should be labeled "Clear Zone" and circled with a station and distance from the design

centerline. Telephone pedestals 150 mm x 150 mm or less are not considered obstacles unless they are supported by a vertical pole larger than 125 mm in diameter or a post larger than 100 mm x 100 mm.

2. Plan View. Show construction limits, location of soil log data and delineated wetlands on the preliminary plans. Where deemed necessary, contour lines and the control traverse may also be shown on preliminary plans.

3. Profile View. Subbase conditions should be noted on the preliminary plans.

4.3.10.4 Plan View

The following presents the recommended guidelines for preparing the plan view:

1. Centerlines. The centerline preferably should be called the "design centerline." The terms "staked centerline" or "projected centerline" may only be used where a conventional survey is used.

2. Horizontal Alignment Data. Chapter Nine presents the criteria for horizontal alignment. Show the horizontal alignment data in the plans as follows:

   a. Horizontal Curve Data. Place horizontal curve data, including super-elevation, inside the curves to which they apply. Figure 4.3G presents the order and rounding accuracy that should be used to present the curve data.

SPIRAL CURVE DATA	SIMPLE CURVE DATA	ACCURACY
Δ	Δ	01° 01’ 01”
RC (existing)	RC (existing)	0.001 m
RC (new)	RC (new)	5 m
L_S		0.01 m
Θ_S		01° 01’ 01”
Δ_S		01° 01’ 01”
Ts	T	0.01 m
Lc	L	0.01 m
Es	E	0.01 m
S	S	1%

HORIZONTAL CURVE DATA
(Plan Sheets)

Figure 4.3G

b. Curve Points. Show perpendicular lines from the design centerline for all curve points. Indicate the curve notation (e.g., PC, PT, SC, TS) and station, to the nearest hundredth of a meter (i.e., 0 + 00.01) along the perpendicular line. Include the PI station with the curve data.

c. Bearings. Write bearing notations below the line to which they apply. Note the bearing in degrees, minutes, or seconds, rounded to the nearest second (i.e., 01E 01N 01O).

d. Offsets. Where a conventional survey is used, note the offsets between the construction and survey centerlines at the beginning and end points where they are parallel to each other.

e. Equations. Equations are used to correct any stationing differences that may occur along the centerline. Show them perpendicular to the design centerline similar to that discussed in Comment "b" above.

3. Topography. The topography shown should include all utilities, irrigation and drainage facilities, buildings and other items pertinent to construction. In general, show existing elements as solid lines and proposed elements in dashed lines. (Existing utilities are shown using the appropriate line code). Include the North arrow, along with the township and range, on all plan sheets and ensure that it is consistent from sheet to sheet. Also list the section with the North arrow unless section corners or section lines are shown on the sheet.

4. Items to be Removed. Show all items within the right-of-way limits that will be removed. Clearly note those items which will be removed by non-contractor personnel.

5. Urban Roadway Widths. Roadway widths should be indicated on the Typical Sections and should not be provided on the plan sheets. However, where a typical section is not provided (e.g., for public approaches), show the roadway width on the plan view measured from the back-of-curb to back-of-curb.

6. Station Call Outs. Provide station call outs at the following locations:

a. beginning and ending points of the project;

b. 100 m station increments;

c. horizontal curve points;

d. beginning and ending points of tapers, including the distance and direction from the design centerline;

e. construction permit locations and right-of-way breaks;

f. curb openings, including the distance and direction from the design centerline;

g. curb ramp locations, including the direction from the design centerline;

h. drainage crossings, inlets, grates, manholes, water valve boxes, sewer crossings, etc., and where applicable, the distance and direction from the design centerline;

i. utility crossings;

j. side street intersections;

k. monument boxes, including the distance and direction from the design centerline;

l. section line ties, right-of-way takes, etc., including the distance and direction from the design centerline;

m. funding limits (e.g., county line, urban to rural change, 2-lane to 4-lane change, reservation boundary); and

n. other locations where deemed appropriate.

7. Drainage. Show all drainage structures in the plan view including culverts, small bridges, storm drainage systems, etc. Sanitary sewers and water mains should be considered as utilities; these are described in Comment #8 below. The following presents several guidelines for placing drainage structures on the plan view:

a. Culverts. For culverts or cross drains the station location, note the pipe size and flow direction. For new installations, unless directed otherwise by the Hydraulics Section, the material type will be at the contractor's discretion and should not be noted on the plans. For existing culverts to remain in place or to be lengthened, note the material type.

b. Bridges. Bridges should be shown on the plan sheet with general bridge details shown in the profile view. Detailed design information will be provided in the bridge plans.

c. Storm Drains. Storm drainage systems or closed drainage systems are provided on the plan view using the line symbols as shown in the MDT CADD Standards Manual. Include the pipe size and type next to the topography symbol. Note all inlet, outlets and manholes and list them according to work description (e.g., NEW MANHOLES, RESET INLETS, PLUG AND ABANDON EXISTING MANHOLES). The listing should include the station location and the distance and direction from the design centerline.

8. Utilities. Where overhead utilities cross the centerline, include notes to indicate the design centerline station, the type of utility, the number of wires and the clearance above the present ground. Where underground utilities cross the centerline, include notes to indicate the design centerline station, the type of utility, and the size and depths of the utility. Provide a listing of the valve boxes or utilities manholes shown in the plan view on each plan sheet. Organize this listing according to the type of work (e.g., ADJUST MANHOLES IN PLACE). Under each heading, the listing should include the station location and the distance and direction from the design centerline.

9. Right-of-Way. The right-of-way plans designer will:

a. show the right-of-way limits on the plan view;

b. note any breaks in the right-of-way alignments by the design centerline station and offset distances;

c. show any easements, construction permits and control of access limits, as applicable; and

d. clearly label each line where the control of access limits do not coincide with the right-of-way limits.

The bearings of the section lines, township lines and range lines crossing the design centerline should be clearly shown as should the station at the point of intersection. Do not use angle call outs.

The road designer will label section lines with the appropriate section numbers. If section lines are not present, show the section number below the North arrow.

10. Guardrail. Show the locations for new and existing guardrail on the plan view.

11. Curb Openings (Laydowns). Where applicable, provide a note on each plan sheet listing the stations, widths and direction from the design centerline for each curb opening located on the sheet.

12. Curb Ramps. Where applicable, provide a note on each plan sheet listing the stations, distance and direction from the design centerline for each curb ramp located on the sheet. Most curb ramps will require additional details.

13. Monument Boxes. Where applicable, provide a note on each plan sheet listing the stations, distance and direction from the design centerline for each monument box located on the sheet.

14. Wetlands. Delineate wetland and wetland impacts. Identify the delineated wetlands with a one-directional cross hatching and areas with wetland impacts with a two-directional cross hatching.

4.3.10.5 Profile View

The following presents the recommended guidelines for preparing the profile view:

1. Existing Ground Line. Show the existing ground line along each profile view as a solid line. See the MDT CADD Standards Manual for the applicable line weights.

2. Vertical Alignment Data. Chapter Ten presents the criteria for vertical alignment. The vertical alignment data should be shown in the plans as follows:

    a. Profile Grade Line. The profile grade line represents the elevation of the top of the finished surfacing at the location shown on the typical section. In superelevated sections, when the typical section defines the profile grade point less normal crown, the profile grade line represents the theoretical elevation of centerline at normal crown.

    b. Vertical Curve Notations. Depict the V.P.C. and V.P.T. with small circles on the profile grade line. The small circle for the V.P.I. should be shown with short segments of the vertical tangents. Note the V.P.I. station (to the nearest hundredth of a meter — 0 + 00.01) and elevation (to the nearest hundredth of a meter — 0.01 m) on the profile view. Place V.P.I. notes vertically above the profile for crest curves and below the profile for sag curves. Do not record the V.P.C. and V.P.T. stations and notations on the profile view.

c. Vertical Curve Lengths. Round the vertical curve calculations determined from Chapter Ten to at least the next highest 20 m increment for new vertical alignments and to the nearest 0.01 m when matching the existing alignment. Write vertical curve lengths horizontally above the profile for sag curves and below the profile for crest curves.

d. Tangent Grades. Show tangent grades to the thousandth of a percent (i.e., 0.001%). Show positive grades with the "+" prefix and negative grades with the "-" prefix. A "+" prefix indicates that the grade is ascending ahead on stationing.

e. Transition Grades. Sections using transition grades (spline curves) should be noted as such.

3. Curb and Gutter Profiles. Where curbing is provided, a supplemental profile will be required, if the curb grade is not parallel to the centerline grade, showing the profile at the flow line of the gutter. Provide a gap in the profile for each curb cut. The criteria presented in Comment #2 also applies to curb profiles. Show the existing ground line on each profile. Show the left-curb profile on the top of the profile view and the right-curb profile on the bottom.

4. Curbing/Sidewalks. Where curbing and/or sidewalks are provided, draw a straight, horizontal line on the bottom portion of the profile view for each curb and/or sidewalk location, including median curbs. Show curbing and sidewalks for the left side on the top, those in the median in the middle and those on the right side on the bottom. Record the sidewalk information including type, location and radii distances on the top of the line. Curb information including type, location and radii distance are provided below the line. Breaks are provided for all curb cuts. Measure all dimensions for curbs from the back of the curb and not the face of curb. See the sample plan sheets in Section 4.4 for additional note designations.

5. Subexcavation. Show subexcavation as a crosshatched area under the profile grade line. The designer should note that the subexcavation should be shown to the top of the subgrade and not to the profile grade line. Each subexcavation location should note the station locations. Show the width and depth of subexcavation on a detail sheet.

6. Drainage Structures. Show mainline cross drainage structures as solid ovals on the profile view. Longitudinal drainage structures are generally not shown unless there may be a potential conflict with utilities, other drainage structures, etc. Where conflicts may occur, provide a supplemental profile; see Comment #9.

Show bridges as a cross-hatched area equal to the length and depth of the superstructure. Also show the riprap at bridge ends.

7. Guardrail. Show new guardrail locations on the profile view as straight, horizontal lines. Provide separate lines for each side of the road. Write the guardrail type above the line. Existing guardrail to be removed will be described in a note on the profile view; see the sample plan sheets in Section 4.4.

8. Vertical Clearances. Show the vertical clearances for all overhead structures on the profile view. Record the minimum clearance distance to the nearest hundredth of a meter (i.e., 0.01 m).

9. Supplemental Profiles Sheets. Supplemental profile sheets may be provided after the plan and profile sheets to illustrate special drainage structures and roadside ditches.

4.3.11 Cross Sections

Cross sections provide a graphical representation of the proposed roadway as compared to the existing ground line. The following sections present the general guidelines for developing cross section sheets.

4.3.11.1 Computer Generated

In general, GEOPAK will generate the line work for the cross sections. The designer should review the user's manuals for GEOPAK to determine how to generate the cross sections. In addition, the designer should consider the following:

1. Orientation. Preferably, draw the cross section horizontally (landscaped) on the sheet. This is the default direction assumed by the computer. If determined to be practical, the cross sections may be drawn vertically (portrait). Show the cross sections from the bottom of page to the top according to increasing stations.

2. Spacing. The computer default spacing between cross sections is approximately 100 mm apart. However, the designer should ensure that there is no overlap of the individual cross section figures, especially in areas of large cuts or fills. Align individual cross sections on a page vertically with the design centerline, or staked line where applicable.

3. Intervals. In rural areas, plot the cross sections at 20 m intervals. For urban areas, plot them at 10 m intervals. Plot additional cross sections at major grade breaks, all pipe crossings, all approaches, all curve control points (TS, SC, CS, ST), all typical section transition points and other locations as deemed necessary.

4. Order. Show the mainline cross sections first, in increasing stations. Individual cross sections of approaches will generally not be shown, except in cases where major construction is conducted for a significant distance along the approach. Where cross sections for side roads, frontage roads, ramps, etc., are provided, place them after the mainline cross section in the order they appear along the mainline. Clearly label each special cross section sheet to allow the user to identify the location of the cross sections.

5. Generated Data. The following cross section information will typically be plotted by GEOPAK:

   a. existing ground line;

   b. proposed top of subgrade line, i.e., the surfacing should not be shown;

   c. design centerline location (staked line if applicable);

   d. station locations;

   e. top of subgrade elevations, placed vertically, to the nearest hundredth of a meter;

   f. groundline elevations along the design centerline or staked line, if applicable (these points should be written diagonally);

   g. roadway slopes for both right and left of the design centerline and offset from staked line, if applicable;

   h. the actual amount of excavation or embankment between stations (no shrink or swell factors are applied), in cubic meters (excavation values are shown on the left and embankment values shown on the right); and

   i. right-of-way limits.

6. Additional Details. The project number, street name or other special cross section identification must be placed as additional drafting details.

4.3.11.2 Additional Plotting Details

Once GEOPAK generates the cross section, the designer may be required to plot the following elements on the cross sections:

1. Drainage. Drainage elements are commonly plotted separately on the cross sections. Section 4.3.11.3 provides additional information on how to present the drainage structures on the cross sections.

2. Utilities. Plot both overhead and underground utilities on the cross section where:

   a. the utility is located longitudinally within the construction limits and for a distance of 100 m beyond the point where the utility enters or exits the construction limits, or

   b. the utility crosses the existing or new design centerline and is located within the construction limits.

3. Grading Notes. Show subexcavation locations on the cross sections. Note the total volume amounts on the cross sections. Show special borrow on the typical section if it is provided in the surfacing recommendations from the Pavement Analysis Section. If it is added later to address a site condition discovered after the surfacing is designed, only show it on the cross sections.

   Additional grading notes may be added to the cross sections to give direction to the contractor (e.g., GRADE TO DRAIN).

4. Structures. Depict buildings, bridges or other structures affected by construction on the cross section sheets.

5. Right-of-way. In general, right-of-way limits will be generated on the cross section by the computer. However, problems may arise on projects with variable right-of-way widths. Under these circumstances the right-of-way limits may need to be plotted on the cross sections separately. Construction permits and easements will generally need to be plotted on the cross sections separately.

6. Ditch Blocks. Label ditch blocks at the closest adjacent cross section of the mainline and note them in the following manner:

   26+10
   DT. BLK. LT.
   20 m3 EMB.+

4.3.11.3 Drainage Structures

The following presents guidelines for showing drainage structures on cross sections:

1. Culverts. Provide individual cross sections for each pipe location. Culverts must be fully described on cross section sheets. Each description should include a drawing and a note or "call out." The sample cross section sheets in Section 4.4 illustrate the procedures for noting culverts on the cross section. In addition, the designer should consider the following.

a. Mainline Culverts Without Skews. Each culvert drawing should show the lines representing the top of the pipe, the flowline of the pipe, bedding and the appropriate end treatment.

b. Mainline Culverts With Skews. Skewed mainline culverts should only be shown skewed if the skew angle is greater than 5E. Large skews may require the use of two cross sections, one for the inlet and one for the outlet. Each drawing should show the lines representing the top of the pipe, the flowline of the pipe, bedding and the appropriate end treatment. The skew line is centered on a grid line which represents the centerline station of the pipe. The skew line is extended left and right of this point at the appropriate skew angle to a line perpendicular to the culvert end drawn on the cross section. Note the centerline station, skew angle, and inlet and outlet stations on the skew line. In addition, show the true angle of skew so that the pipe lengths can be scaled from the skew line.

c. Approach Pipes. The cross section figures in Section 4.4 illustrate the correct procedure for noting a sample approach pipe application.

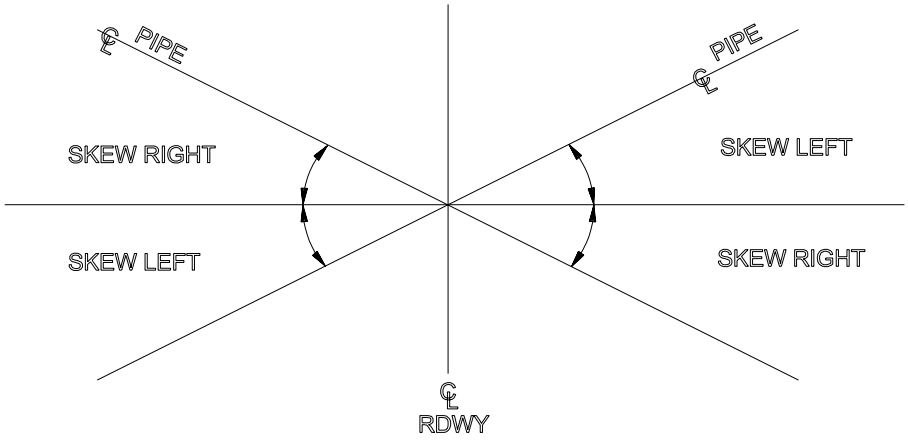
d. Notes. Culvert drawings should be supplemented with notes containing the following data, as appropriate:

1) station location of culvert at the design centerline;

2) description of pipe, including material type (if no option), length, inside diameter, or rise and span;

3) amount of skew in degrees, measured right or left as shown in Figure 4.3H;

4) description of end treatment;



SKEW MEASUREMENTS

Figure 4.3H

5) maximum or minimum height of cover, measured from the top of the pipe to the top of the finished grade;

6) cubic meters of culvert excavation;

7) quantity of bedding material;

8) quantity of concrete;

9) quantity of culvert riprap for edge protection; and/or

10) quantity of foundation material and geotextile.

2. Drop Inlets and Storm Drain. Drop inlets and storm drains should be detailed on the cross sections unless a separate detail sheet is included in the plans.

3. Drain Ditches. Inlet and outlet drain ditches should be drawn on the cross sections, and should be described by notation wherever they are used. Each note should indicate the station location, the cubic meters of additional excavation, whether it is an inlet ditch or an outlet ditch and whether it is left or right of the mainline. A typical note is shown below:

73 + 50
OUTLET DT. LT.
20 m3 ADD. EXC.

4. Irrigation Facilities. All irrigation facilities should be shown on the cross section by the designer. However, they will be designed and detailed by the Hydraulics Section. A typical note on the cross section for irrigation facilities is shown below:

71 + 75
NEW 600 mm x 40 m SIPHON
SKEW 20E RT.
1.4 m3 CL. DD CONC. (INLET & OUTLET HEADWALLS)
1.4 m COVER
80 m3 CULV. EXC.
SEE DETAIL SHEET

5. SSPPC Installations. Structural steel plate pipe arch culverts will be shown on the cross sections. However, they will be designed and detailed by the Hydraulics Section. A typical note for large culverts is shown below:

200 + 00
NEW 1.524 m x 36.5 m SSPPC DRAIN, 3.56 mm THK.
SKEW = 30E LT
2:1 STEP BEVELED END
4.5 m3 CLASS DD CONC. CUTOFF WALLS LT. AND RT.
3.4 m3 CLASS DD CONC. EDGE PROTECTION - INLET
23.4 m3 CLASS I CULVERT RIPRAP - OUTLET
108 m3 BEDDING MATERIAL
3.2 m COVER
130 m3 CULVERT EXC.

4.3.12 Erosion Control Plan

The designer will prepare an erosion control plan for projects requiring a Department of Environmental Quality "General Discharge Permit for Stormwater Associated with Construction Activity." The erosion control plan consists of best management practices (BMP) to be used at each site marked on plan sheets that correspond to stationing of the construction plans. The designed finished grade contours are also shown on the erosion control plan sheets. The Road Design Section will submit the erosion control plan, a complete set of construction plans and cross sections to Environmental Services

at the completion of the Plan-in-Hand inspection. Environmental Services will review the erosion control plan and return recommendations for modifications of the plan to the designer. The final erosion control plan and documentation will be submitted by Environmental Services to the Department of Environmental Quality.

4.4 SAMPLE PLAN SHEETS

To assist the designer in developing a set of plans, this section provides several sample plan sheets. Although these plan sheets present a major portion of the information required on plan sheets, the designer may need to make adjustments to match field conditions for each individual project. Figure 4.4A provides a list of the plan sheets illustrated in this Section.

PLAN SHEET	FIGURE #
Title Sheet	Figure 4.4B
Table of Contents	Figure 4.4C
Notes	Figure 4.4D
Linear and Level Data	Figure 4.4E
Control Traverse Diagram with Abstract Table	
Typical Sections	
- rural reconstruction project	Figure 4.4G
- rural reconstruction with rumble strips	Figure 4.4H
- urban reconstruction project	Figure 4.4I
- cement treated base	Figure 4.4J
Summaries	Figure 4.4K-1 — K-10
Hydraulic Data	Figure 4.4L
Details - Mass Diagram	Figure 4.4M-1 — M-7
Plan and Profile	
- rural reconstruction project	Figure 4.4N
- urban reconstruction project	Figure 4.4O
- bridge replacement project	Figure 4.4P
- line diagrams with R/W involvement	Figure 4.4Q
- straight-line diagram for overlays	Figure 4.4R
Cross Sections	
- with pipes	Figure 4.4S-1 — S-5
- with topography	Figure 4.4T-1 & T-2

SAMPLE PLAN SHEET SUMMARY

Figure 4.4A